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Feng et al.

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(54) **LIGHT-CANCELLING RING FOR RETAINING CAMERA LENS AND LENS MODULE USING SAME**

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G02B 7/02 (2021.01)

(52) **U.S. Cl.**
CPC ***G02B 7/026*** (2013.01); ***G02B 7/021*** (2013.01)

(58) **Field of Classification Search**
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USPC 359/830
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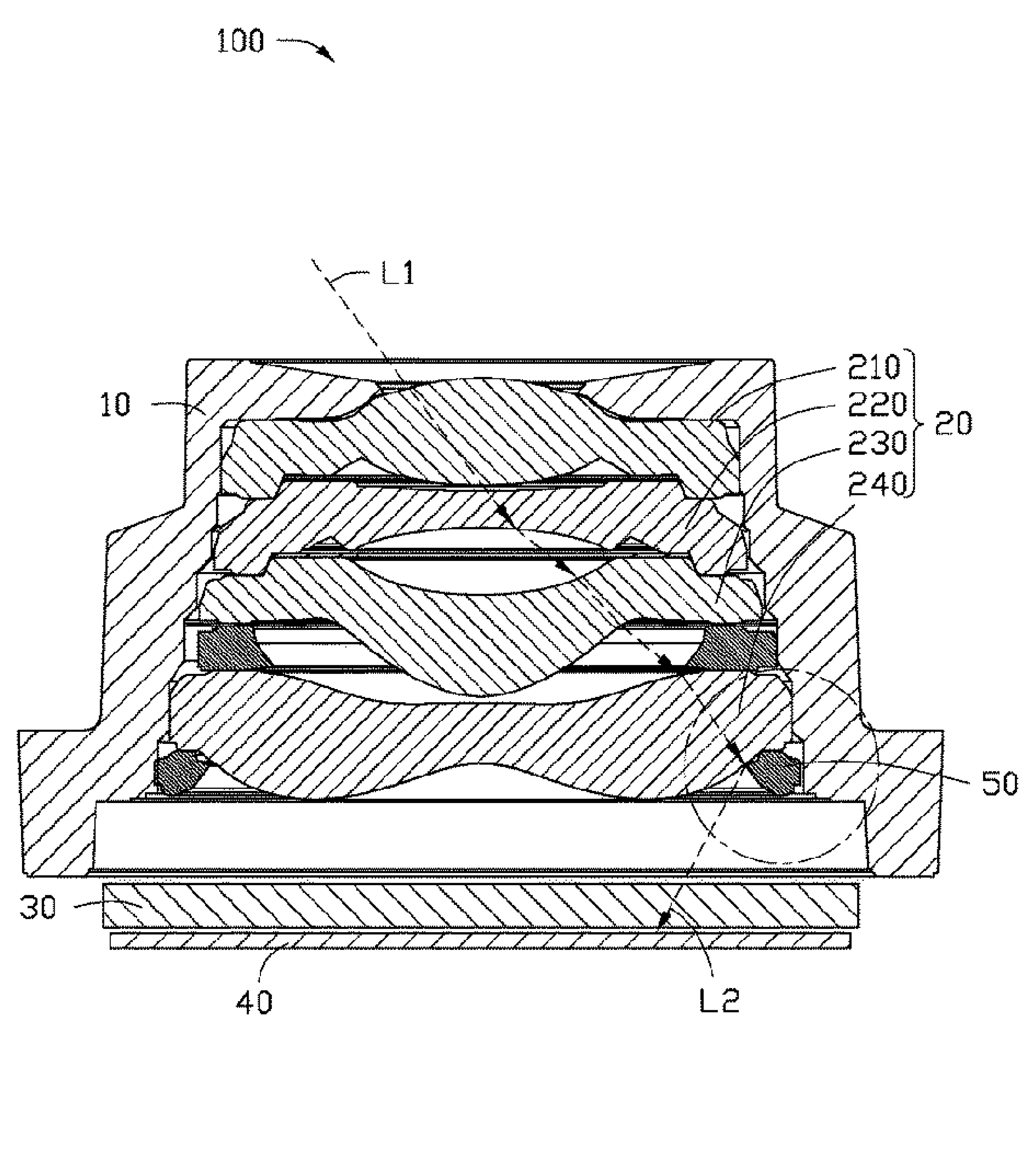
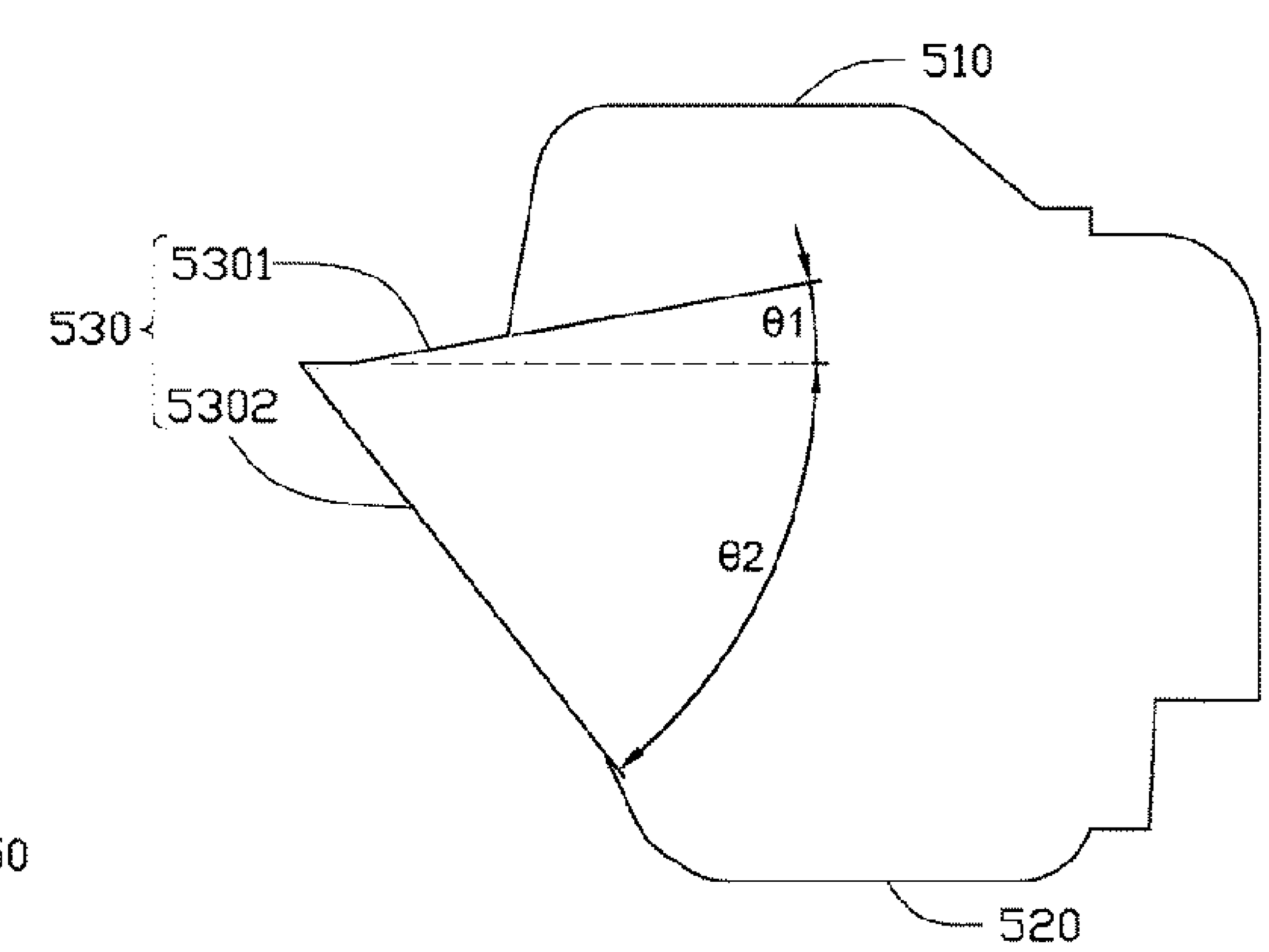
(57) **ABSTRACT**

A retaining ring for retaining lenses in a lens module carries an internal shape reducing the incidence of stray reflected light. The through hole in the retaining ring allows light to pass and a prismatic protrusion is disposed on a wall of the through hole. The protrusion has first and second inclined surfaces each at a specific angle. Acute angle θ1 is formed between the first inclined surface and end surface of ring, and acute angle θ2 is formed between the second inclined surface and other end surface of ring. Relationship between the acute angles are θ1>θ2, and 60°≤θ1+θ2≤80°. A lens module using such a retaining ring is also provided.

10 Claims, 7 Drawing Sheets





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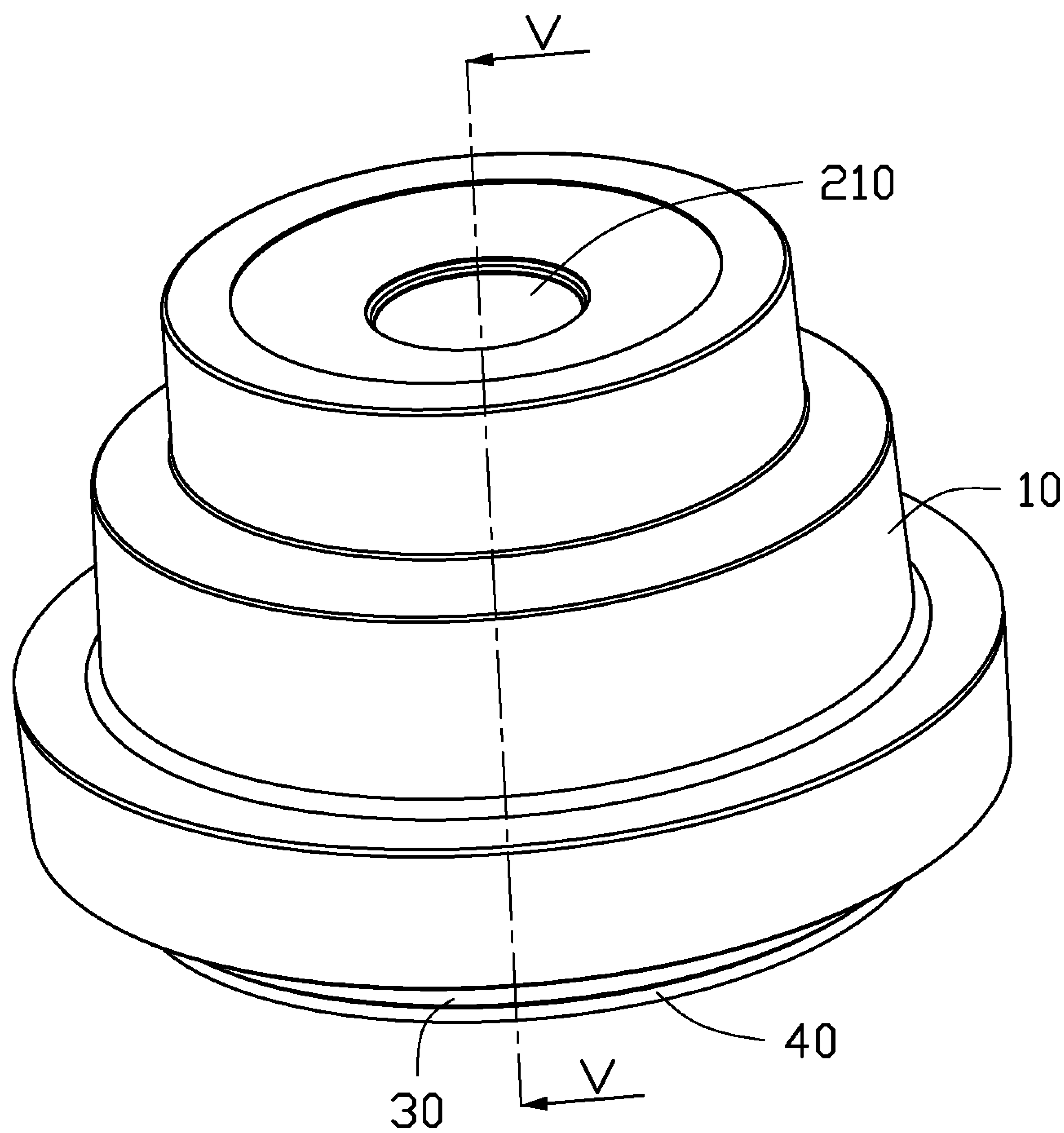

FIG. 1

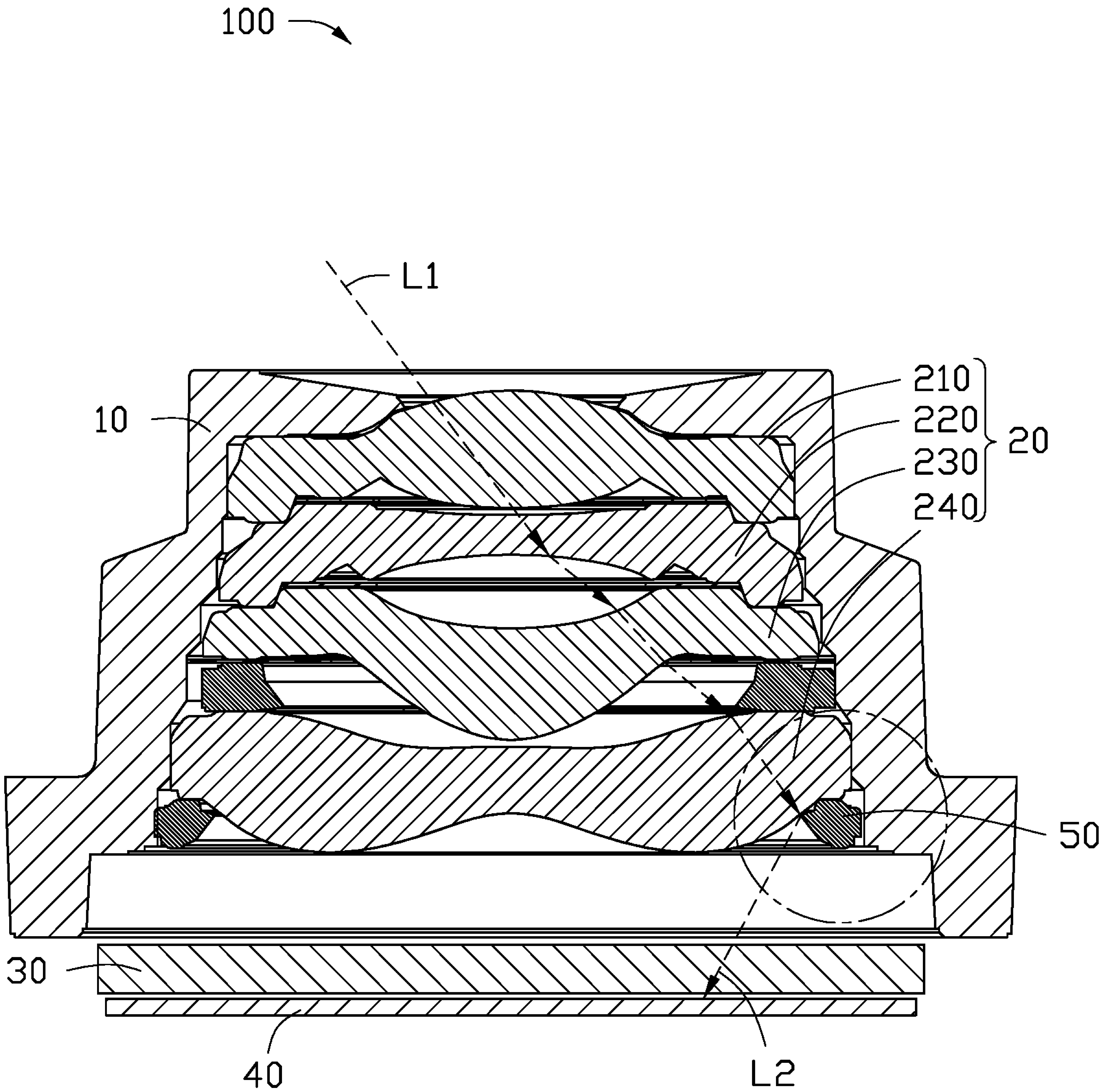

FIG. 2

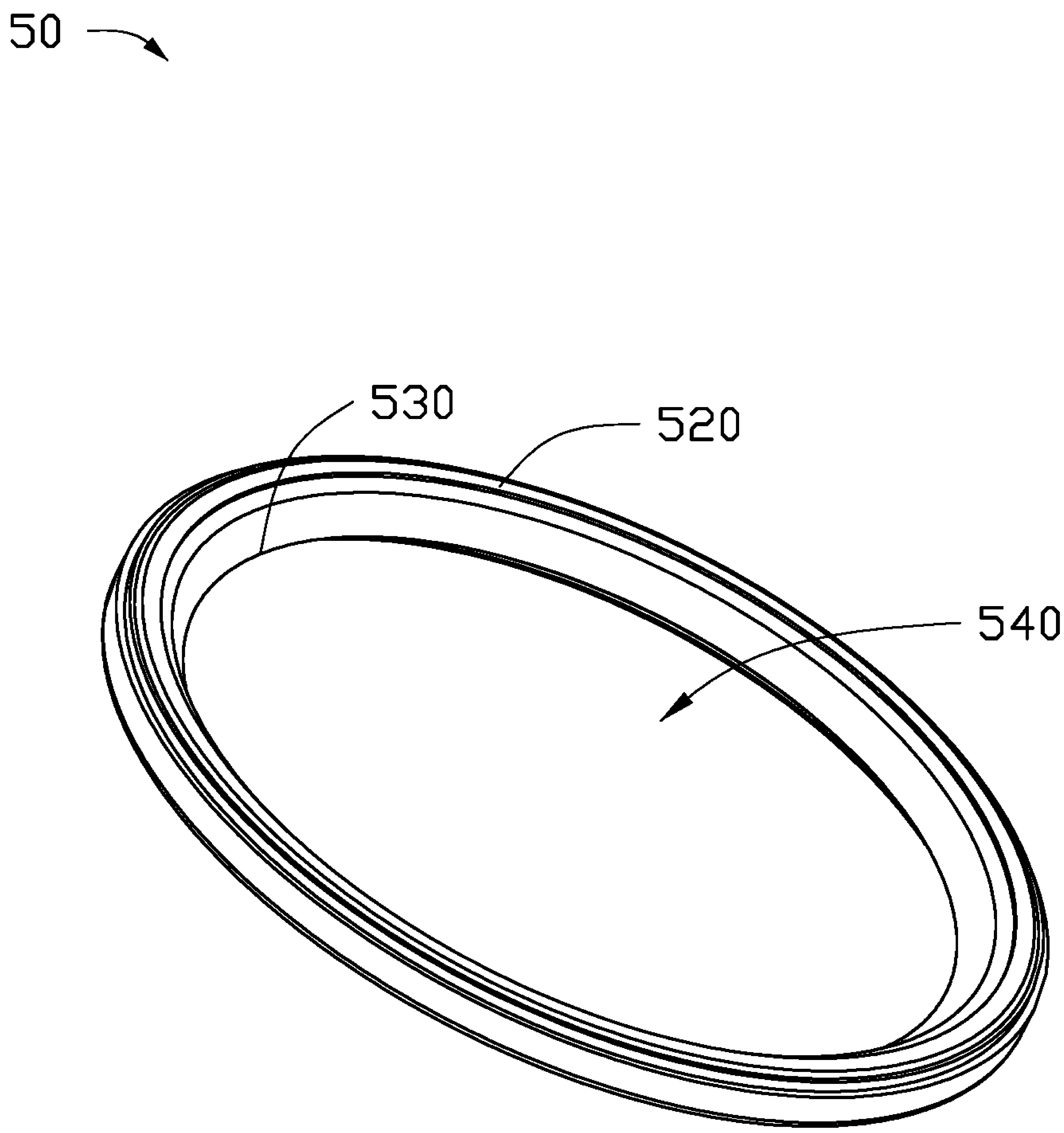

FIG. 3

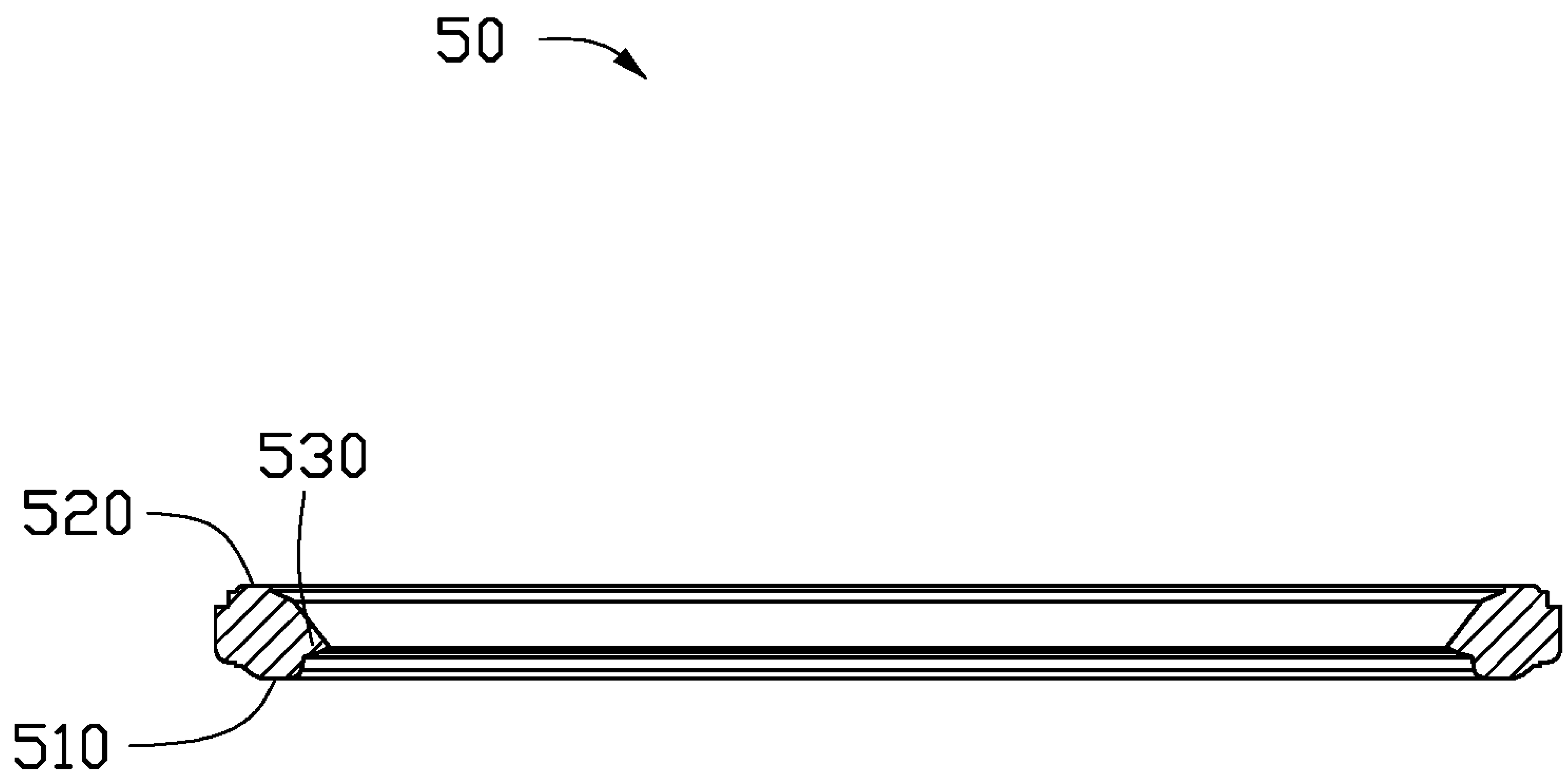

FIG. 4

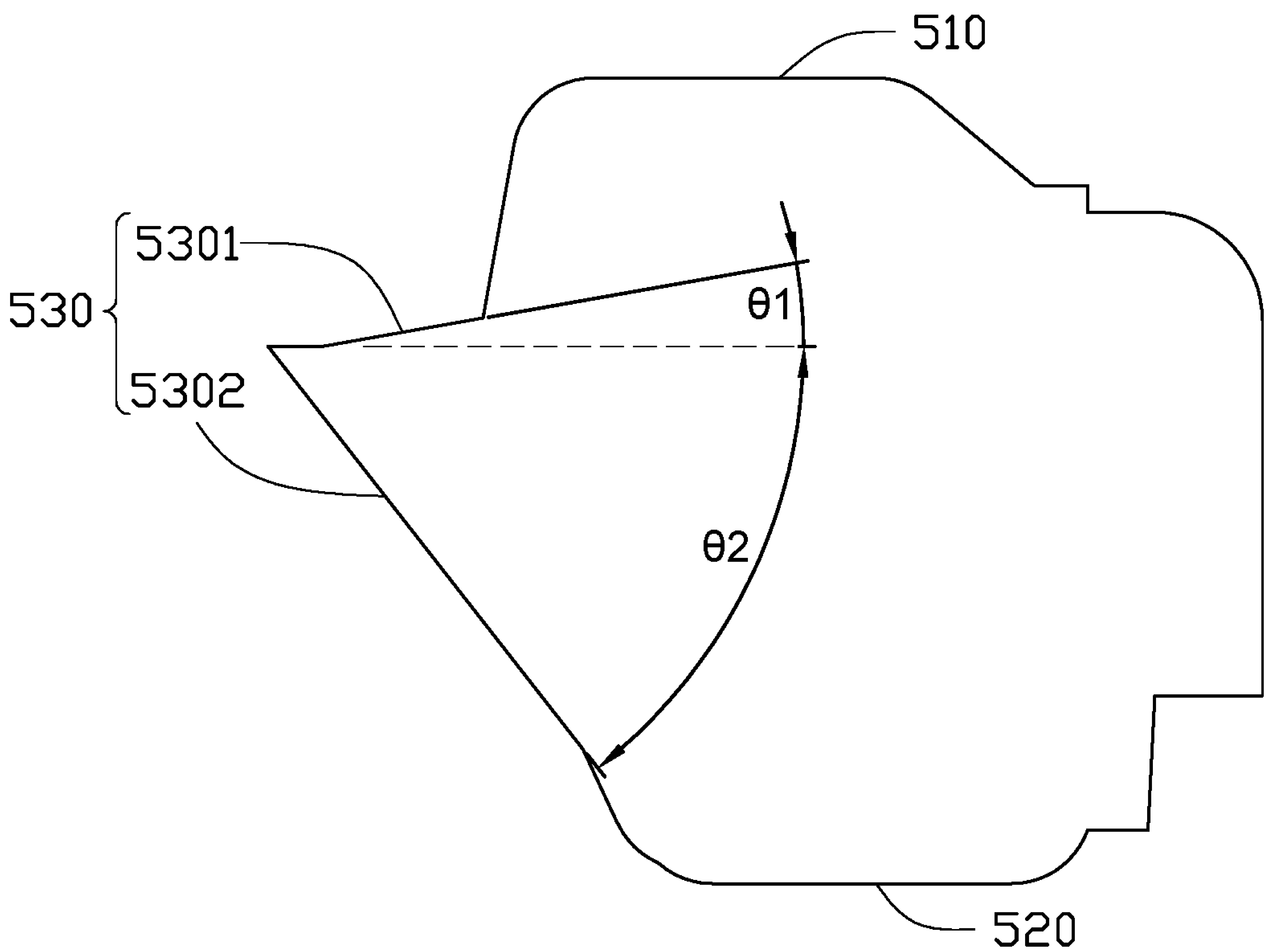

FIG. 5

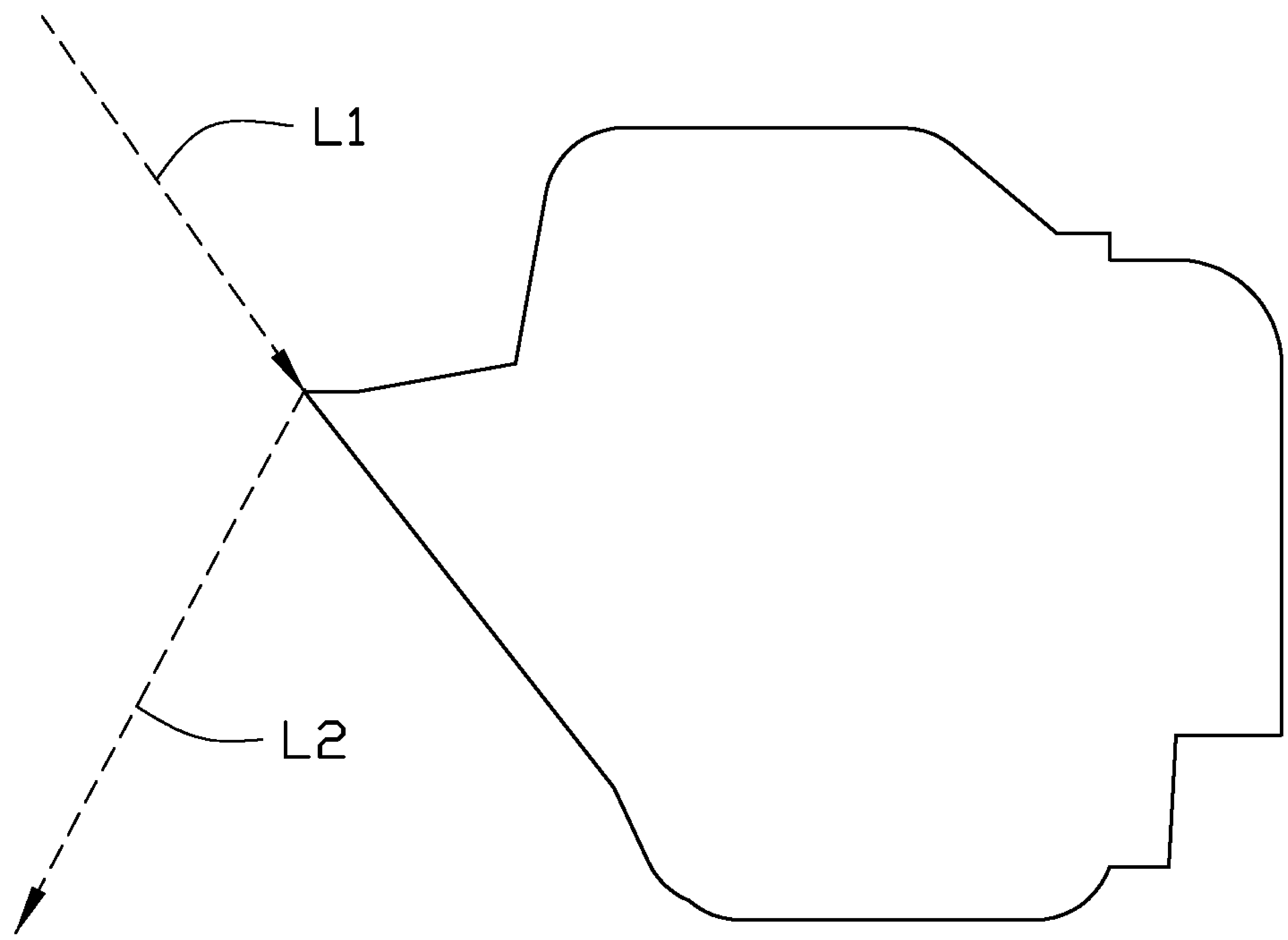

FIG. 6

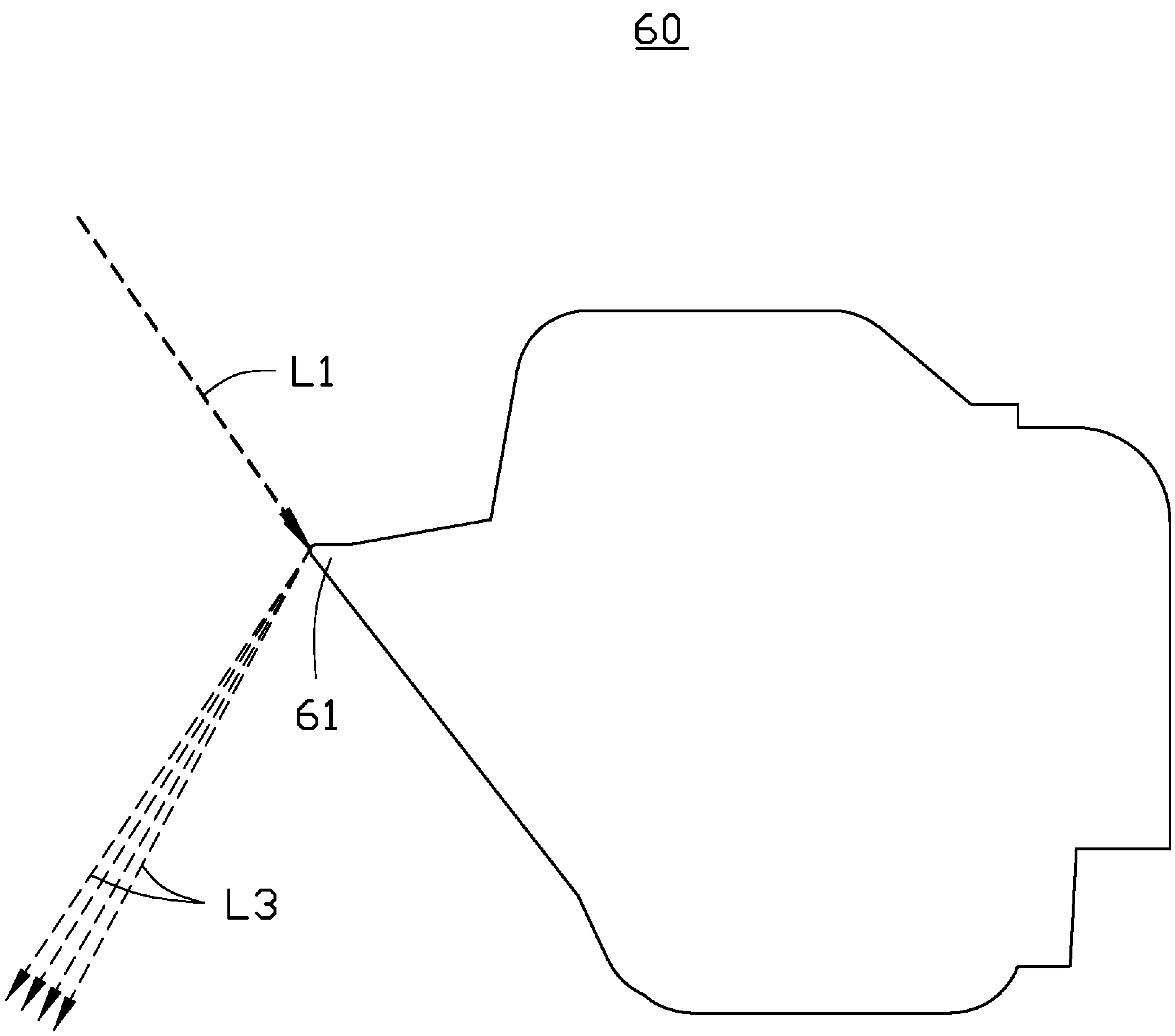

FIG. 7 (Prior art)

LIGHT-CANCELLING RING FOR RETAINING CAMERA LENS AND LENS MODULE USING SAME

FIELD

The subject matter herein generally relates to imaging.

BACKGROUND

A lens module is often fixed by UV glue to keep the lenses in a lens group together. If the glue is thin or the glue has a high reflectivity, it will result in flares which come from transmittance of light rays through the nearest lens to the image sensor, thereby affecting the lens imaging quality. A retainer is usually assembled to the lens closest to the image sensor. With the retainer, the lens group is reinforced, meanwhile, and most flares are blocked and reduced.

In the molding process of retainer, it is difficult to make the structure of inner section of a retainer to be an absolutely sharp tip because the absolutely sharp tip does not really exist. The smaller the angle of the tip is, the harder the molding process is. Moreover, it has extreme difficulty to get both similar and higher sharpness status of tips of retainer during mass production due to the limit of molding process. On the other hand, increased reflection of light rays comes with an unsharp tip of the retainer, which is also followed by periodic flares.

Therefore, there is room for improvement.

BRIEF DESCRIPTION OF THE DRAWINGS

Implementations of the present technology will now be described, by way of embodiments, with reference to the attached figures.

FIG. **1** is an isometric view of a lens module according to an embodiment of the present disclosure.

FIG. **2** is a cross-sectional view along line V-V of FIG. **1**, illustrating an optical path of light.

FIG. **3** is an isometric view of a retaining ring in the lens module of FIG. **1**.

FIG. **4** is a cross-sectional view of the retaining ring of FIG. **3**.

FIG. **5** is a cross-sectional view of part of the retaining ring of FIG. **3**.

FIG. **6** illustrates an optical path of light reflected by the retaining ring of FIG. **5**.

FIG. **7** illustrate, in prior art, optical paths of light reflected by a retaining ring in a lens module.

DETAILED DESCRIPTION

The present disclosure is made in conjunction with the accompanying drawings. Specific embodiments of the present disclosure are described.

In the following description, when an element is described as being "fixed to" another element, the element can be fixed to the another element with or without intermediate elements. When an element is described as "connecting" another element, the element can be connected to the other element with or without intermediate elements.

Without a given definition otherwise, all terms used have the same meaning as commonly understood by those skilled in the art. The term "and/or" means including any and all combinations of one or more of associated listed items.

Referring to FIGS. **1** and **2**, the lens module **100** includes a lens barrel **10**, a lens group **20**, a filter **30**, an image sensor **40**, and a retaining ring **50**.

The lens group **20**, the retaining ring **50**, the filter **30**, and the image sensor **40** are sequentially arranged from object to image sides of the lens module **100**.

The lens group **20** includes a plurality of lenses. The lenses are housed and fixed in the lens barrel **20**. The retaining ring **50** is fixed to the lens group **20** on the innermost side of the lens module **100**, to prevent the lens group **20** falling out of the lens barrel **10**. An outer diameter of the retaining ring **50** matches the size of an inner wall of the lens barrel **10** to meet gap requirement of the optical design.

Referring also to FIGS. **3** to **5**, the retaining ring **50** includes a first end surface **510** and a second end surface **520** opposite and parallel to the first end surface **510**. The middle portion of the retaining ring **50** defines a through hole **540**. The through hole **540** runs through both the first end surface **510** and the second end surface **520** for allowing light to pass. The retaining ring **50** further includes a prismatic protrusion **530** disposed on the wall of the through hole **540**.

The prismatic protrusion **530** includes a first inclined surface **5301** and a second inclined surface **5302**. One side of the first inclined surface **5301** is connected to the first end surface **510**. One side of the second inclined surface **5302** is connected to the second end surface **520**, and other side of the second inclined surface **5302** is connected to other side of the first inclined surface **5301**. In the embodiment, the first inclined surface **5301** can be connected to the first end surface **510** directly or indirectly. The second inclined surface **5302** can be connected to the second inclined surface **5302** directly or indirectly. A first acute angle $\theta 1$ is formed between the first inclined surface **5301** and the first end surface **510**, and a second acute angle $\theta 2$ is formed between the second inclined surface **5302** and the first end surface **510**. Relationships between the first acute angle $\theta 1$ the second angle $\theta 2$ are $\theta 2>\theta 1$, and $60°\leq\theta 1+\theta 2\leq 80°$.

In the embodiment, the first acute angle $\theta 1$ is 20° and the second acute angle $\theta 2$ is 52°.

In the embodiment, the lens group **20** includes a first lens **210**, a second lens **220**, a third lens **230**, and a fourth lens **240**. The first lens **210**, the second lens **220**, the third lens **230**, and the fourth lens **240** are sequentially disposed from object to image sides of the lens module **100**.

The first lens **210** has a positive dioptric value. The first lens **210** includes a first surface protruding toward the object side and a second surface protruding toward the image side. For example, in the embodiment, the first surface can be a spherical surface protruding toward the object side, and the second surface can be a spherical surface protruding toward the image side.

The second lens **220** has a negative dioptric value. The second lens **220** includes a third surface recessed toward the image side and a fourth surface recessed toward the object side. For example, in the embodiment, the third surface is a curved surface recessed toward the image side, and the fourth surface is a curved surface recessed toward the object side. The fourth surface has a radius of curvature greater than that of the third surface.

The third lens **230** has a positive dioptric value. The third lens **230** includes a fifth surface and a sixth surface that are both recessed toward the image side. For example, in the embodiment, the fifth surface may be a spherical surface that is recessed toward the image side. The sixth surface is a spherical surface recessed toward the image side. The fifth surface has a curvature different from that of the sixth surface.

The fourth lens **240** has a negative dioptric value. The fourth lens **240** includes a seventh surface and an eighth surface. The seventh surface and the eighth surface are both recurved aspherical surfaces.

In the embodiment, the first end surface **510** faces the object side of the lens module **100**, and the second end surface **520** faces the image side of the lens **100**.

A size of an aperture of the through hole **540** gradually decreases from object to image sides along the first inclined surface **5301**. Meanwhile, the size of the aperture of the through hole **540** gradually decreases along the second inclined surface **5302** from image to object sides.

Referring to FIG. **6** to FIG. **7**, the sharp prismatic protrusion **530** reduces the reflectance of light rays to the image sensor **40**. Only the light rays L**1** reflected by the tip end of the prismatic protrusion **530** enter the image sensor **40**, stray light rays to the image sensor **40** are reduced and the image quality is improved.

FIG. **7** indicates the prior art. Since the protruding tip **61** of the inner side of the retaining ring **60** is subjected to molding compromises, the reflected light L**1** is diffused and a greater amount of stray light L**2** enters the image sensor (not shown).

The provision of the first inclined surface **5301** and the second inclined surface **5302** reduces stray light rays, and the difficulty of forming the retaining ring **50** is also reduced.

The embodiments shown and described above are only examples. Even though numerous characteristics and advantages of the present technology have been set forth in the foregoing description, together with details of the structure and function of the present disclosure, the disclosure is illustrative only, and changes can be made in the detail, including in matters of shape, size, and arrangement of the parts within the principles of the present disclosure, up to and including the full extent established by the broad general meaning of the terms used in the claims.

What is claimed is:

1. A retaining ring configured for fixing to a lens group of a lens module on a light exiting side of the lens module, the retaining ring comprising a first end surface and a second end surface opposite and parallel to the first end surface, wherein a middle portion of the retaining ring defines a through hole to allow light to pass, the retaining ring further comprises a prismatic protrusion disposed on a wall of the through hole, the prism protrusion comprises a first inclined surface and a second inclined surface, one side of the first inclined surface is connected to the first end surface, one side of the second inclined surface is connected to the second end surface, and other side of the second inclined surface is connected to other side of the first inclined surface, an acute angle θ1 is formed between the first inclined surface and the first end surface, and an acute angle θ2 is formed between the second inclined surface and the first end surface, and relationships between the acute angles θ1 and θ2 are: θ2>θ1, and 60°≤θ1+θ2≤80°.

2. The retaining ring according to claim **1**, wherein the first end surface faces an object side of the lens module, and the second end surface faces an image side of the lens module; a size of an aperture of the through hole gradually decreases along the first inclined surface from the object side to the image side.

3. The retaining ring according to claim **1**, wherein the first end surface faces an object side of the lens module, and the second end surface faces an image side of the lens module; a size of an aperture of the through hole decreases along the second inclined surface from the image side to the object side.

4. The retaining ring according to claim **1** wherein the acute angle θ1 is 20° and the acute angle θ2 is 52°.

5. The retaining ring according to claim **1**, wherein the first inclined surface is connected to the first end surface indirectly, and the second inclined surface is connected to the second end surface indirectly.

6. A lens comprising:

a lens barrel;

a lens group, housed in the lens barrel and comprising a plurality of lenses;

a filter;

an image sensor; and

a retaining ring;

wherein the lens group, the retaining ring, the filter, and the image sensor are sequentially arranged from an object side of the lens module to an image side of the lens module, the retaining ring is fixed to the lens group on a light exiting side of the lens module, the retaining ring comprises a first end surface and a second end surface opposite and parallel to the first end surface, a middle portion of the retaining ring defines a through hole to allow light to pass, the retaining ring further comprises a prismatic protrusion disposed on a wall of the through hole, the prismatic protrusion comprises a first inclined surface and a second inclined surface, one side of the first inclined surface is connected to the first end surface, one side of the second inclined surface is connected to the second end surface, and other side of the second inclined surface is connected to other side of the first inclined surface, an acute angle θ1 is formed between the first inclined surface and the first end surface, and an acute angle θ2 is formed between the second inclined surface and the first end surface, and relationships between the acute angles θ1 and θ2 are: θ2>θ1, and 60°≤θ1+θ2≤80°.

7. The lens according to claim **6**, wherein the first end surface faces the object side of the lens module, and the second end surface faces the image side of the lens module; a size of an aperture of the through hole gradually decreases along the first inclined surface from the object side to the image side.

8. The lens according to claim **6**, wherein the first end surface faces the object side of the lens module, and the second end surface faces the image side of the lens module; a size of an aperture of the through hole gradually decreases along the second inclined surface from the image side to the object side.

9. The lens module according to claim **6**, wherein the acute angle θ1 is 20° and the acute angle θ2 is 52°.

10. The lens module according to claim **6**, wherein the first inclined surface is connected to the first end surface indirectly and the second inclined surface is connected to the second end surface indirectly.

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